416 Fire Burned Area Emergency Response (BAER) Executive Summary

San Juan National Forest, Durango, Colorado
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FIRE BACKGROUND

The 416 Fire started on June 1, 2018 approximately 13 miles north of Durango, Colorado. The majority of the fire is on the San Juan National Forest in the Hermosa Special Management Area and Hermosa Wilderness. While total containment of the 416 Fire is not expected until after the start of the July monsoon rains, a Burned Area Emergency Response (BAER) assessment was initiated in late June as the flooding and debris flow from the rains could pose significant threats to roads, trails, homes and private property within and downstream of the fire. This initial BAER assessment covers the first 34,400 acres burned from the 416 Fire and identifies risks to public safety and infrastructure that may result from the first damaging storm. Since the assessment was initiated, the fire size has increased to over 54,000 acres and a follow-up BAER assessment will be completed as the fire nears containment.

Hermosa Creek Drainage

BAER PROCESS

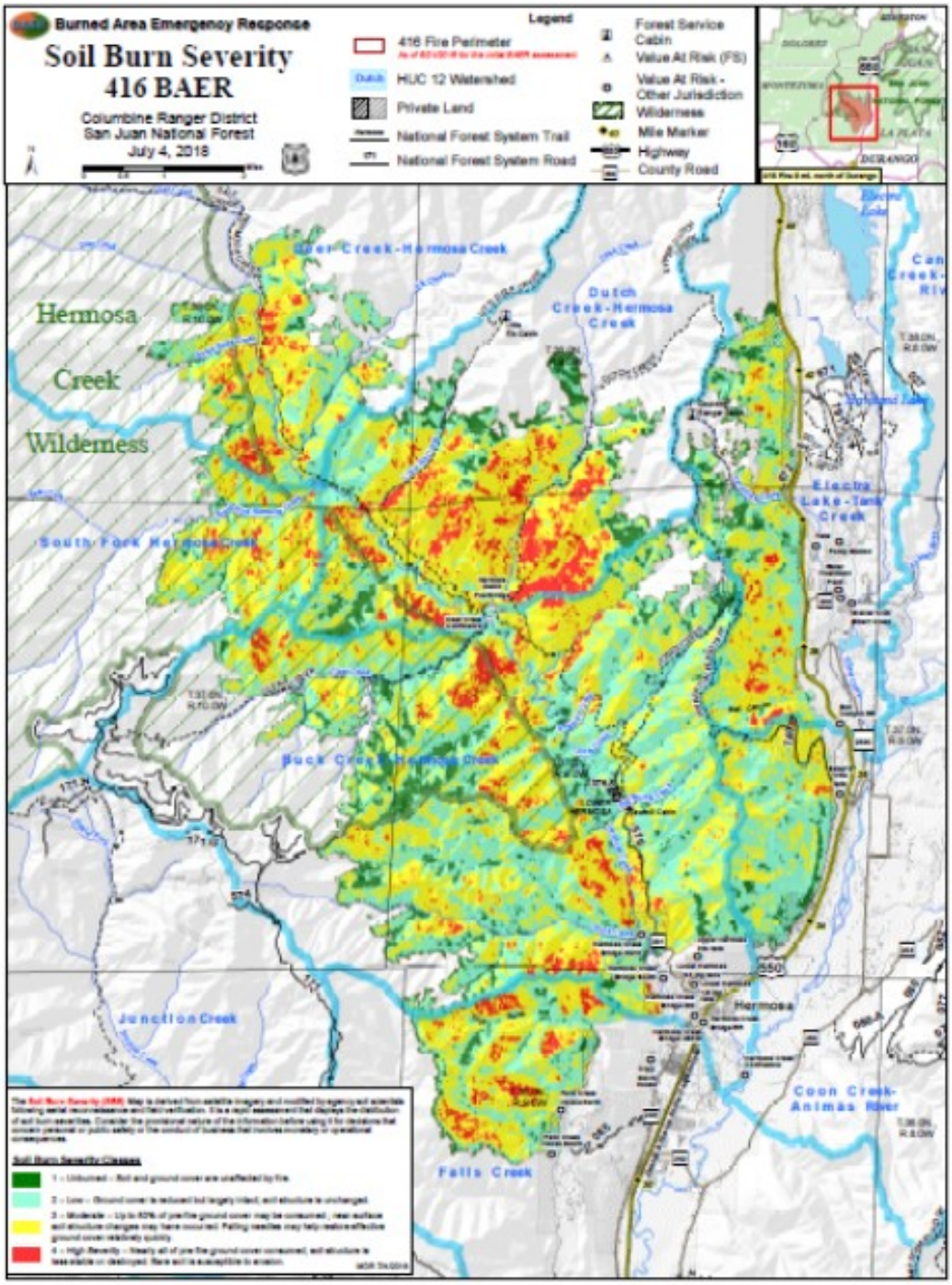
The BAER assessment focuses on determining where post-fire precipitation events could increase runoff, flooding, erosion and sediment delivery, and where high-risk areas are for the spread of invasive weeds. Hydrologists, soil scientists, engineers, weed specialists, archaeologists, wildlife/fisheries biologists, and GIS analysts all contributed to the BAER assessment. In addition to contributions from the assessment team, the US Geological Survey (USGS) provides models on debris flow potential following the fire.

The BAER team identifies 'Values at Risk' (VAR) which include human life and safety, infrastructure, private property, natural resources, and cultural resources. The team develops a Soil Burn Severity (SBS) map to document the degree to which soil properties changed as a result of the fire within the burned area. Fire damaged soils have low strength, high root mortality, and increased rates of water runoff and erosion. Using the SBS map, BAER team members run models to estimate changes in stream flow and debris flow potential. The models compare pre-fire conditions to predicted post-fire conditions to determine relative changes as a result of the fire. These models are then used to determine the relative risk to different VAR's, and are used to make recommendations to address high risk areas determined to be an emergency. Modelling results are not intended for site specific actions such as sizing culverts or mitigating a specific area, but rather to identify areas of high to moderate probability of flooding or debris flow.

ANALYSIS OVERVIEW

In mid-June, the U.S. Forest Service Geospatial and Technology and Applications Center provided the BAER team with an initial Burned Area Reflectance Classification (BARC) map derived from satellite imagery that compares pre and post fire images. The team conducted reconnaissance and field verification surveys to adjust the BARC and create a final soil burn severity map (Figure 1).

Figure 1 Burned Soil Severity Map



Burn Severity	Acres	Percent of burned area
Unburned	**3,225**	**9%**
Low Severity	**12,567**	**37%**
Moderate Severity	16,029	47%
High Severity	2,571	7%

Physical Characteristics of the Burned Landscape

SOILS

An estimated 54% of the area within the 416 Fire perimeter had high or moderate SBS and may have developed water repellent soils as a result of the fire. Water repellent soils develop when organic material (dead plant debris) on the soil surface burns during a fire, releasing waxy substances that coat soil particles—basically "shrink-wrapping" the soil and filling in the pores that would normally allow water to soak in during rain events. When water can't infiltrate into the soil because the pores are blocked, water runs over the surface causing erosion and increased flood potential.

Soil erosion models indicate that relative to pre-fire conditions, erosion rates are expected to increase from negligible to 7.5 tons of soil per acre. For perspective, one acre of soil equal to the thickness of one sheet of paper is equal to one ton of sediment. The increased erosion can result in downstream sediment delivery and increased flooding affects. Increased sediment can also block culverts and other infrastructure and degrade water quality.

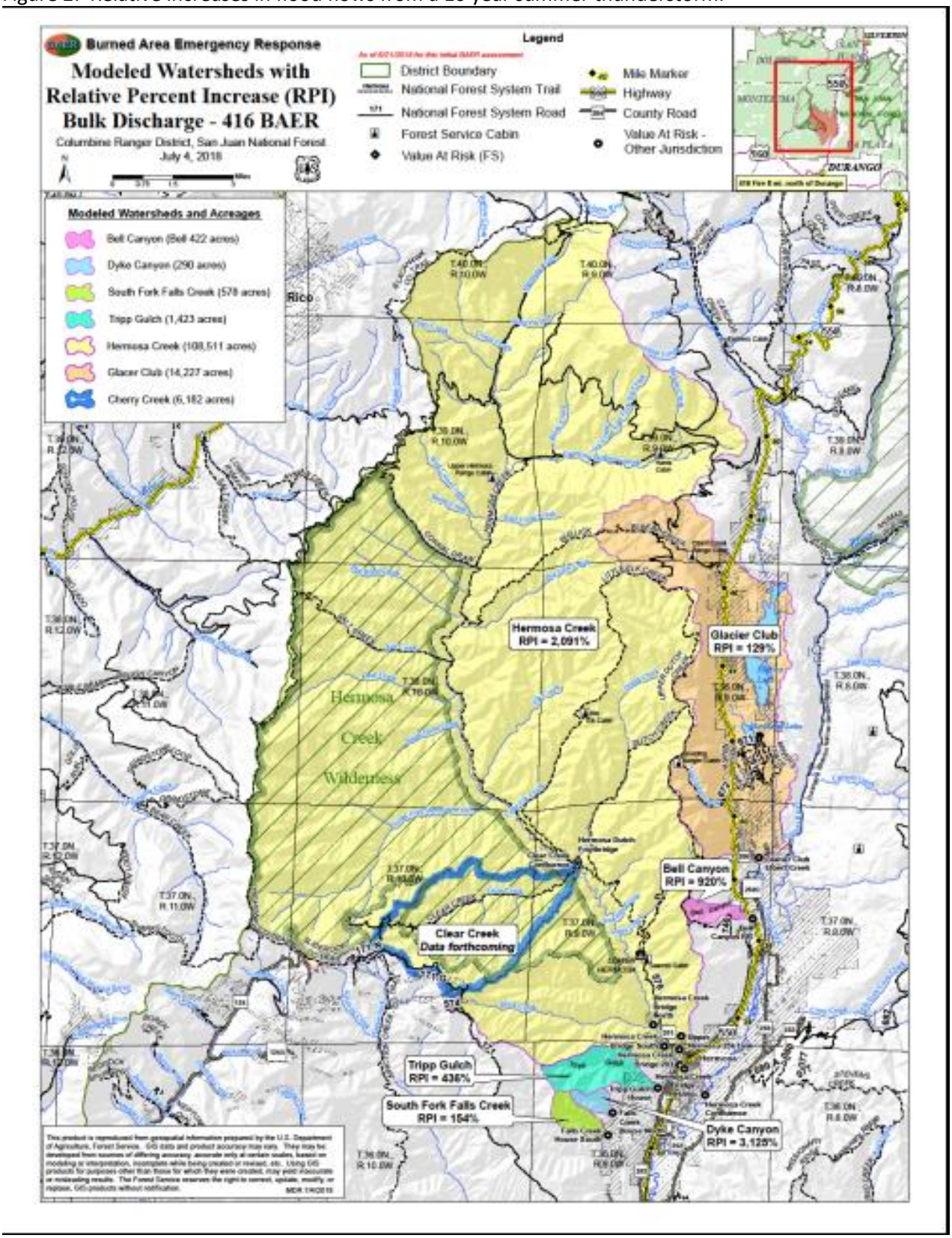
While soils in high severity burned areas may lose some productivity and vegetative recovery will be slow, over time, natural processes will result in effective revegetation of these soils. Soil loss may be greater in localized patches but these impacts are not considered significant and will not result in permanent impairment of soil productivity in the long-term (10 years).

Moderate Soil Burn Severity

HYDROLOGY

Prior to the fire, the surface duff and litter acted as a 'sponge' that naturally absorbed water during rainfall events and promoted infiltration into the soils. Post-fire, the loss of the surface cover in combination with newly created water repellent soils results in increased flooding, particularly downstream of areas of high and moderate soil burn severity. Relative increases in flood flows for after summer thunderstorms for selected watersheds are displayed in Figure 2.

Figure 2: Relative increases in flood flows from a 10 year summer thunderstorm.


Burned Area Emergency Response
Modeled Watersheds with Relative Percent Increase (RPI) Bulk Discharge - 416 BAER
Columbine Ranger District, San Juan National Forest
July 4, 2018
Legend
District Boundary
National Forest System Trail
National Forest System Road
Forest Service Cabin
Value At Risk (FS)
Mile Marker
Highway
County Road
Value At Risk - Other Jurisdiction
Modeled Watersheds and Acreages
Bell Canyon (Bell 422 acres)
Dyke Canyon (290 acres)
South Fork Falls Creek (578 acres)
Tripp Gulch (1,423 acres)
Hermosa Creek (108,511 acres)
Glacier Club (14,227 acres)
Cherry Creek (6,182 acres)
Rico
Hermosa Creek RPI = 2,091%
Glacier Club RPI = 129%
Hermosa Creek Wilderness
Bell Canyon RPI = 920%
Clear Creek Data forthcoming
Tripp Gulch RPI = 436%
South Fork Falls Creek RPI = 154%
Dyke Canyon RPI = 3,128%
DURANGO

The most damaging post-fire effects are likely to occur in the next few months after high intensity summer thunderstorms. In the larger Hermosa Creek watershed, the predicted flood flows are still below spring peak flows that occur from snowmelt runoff. Existing infrastructure should be able to accommodate these increased summer flows. However, there is a chance that increased debris and logs from the burn area will collect and create debris and log dams that could subsequently dislodge and cause outburst floods. This could pose a serious risk to life and property downstream during high flow events since they carry logs, rocks, and a deluge of mud.

In the smaller watershed areas of Tripp Gulch and Dyke Canyon, runoff from post-fire rainfall events could exceed pre-fire peak flows. The channels in these canyons are smaller and there is less room for the flood waters to spread out, increasing velocity and erosion potential.

GEOLOGY

Debris flows from burned logs are among the most hazardous consequences of rainfall on burned hillslopes. Debris flows pose a hazard distinct from other sediment-laden flows because of their unique destructive power. Debris flows can occur with little warning and can exert great impulsive loads on objects in their paths. Even small debris flows can strip vegetation, block drainage ways, damage structures, and endanger human life. Additionally, sediment delivery from debris flows can "bulk" the volume of flood flows, creating an even greater downstream flooding hazard. The U.S. Geological Survey (USGS) used the SBS map in their modeling to predict risk of debris flows (Figure 3). The area of concern for debris flow center on the south eastern area of the Fire, adjacent to private lands. Debris flows are likely in the upper Hermosa drainage, but will likely dissipate within the low gradient Hermosa Creek channel. The results of the USGS debris flow modelling effort will be available at: http://landslides.usgs.gov/hazards/postfire_debrisflow/2018.

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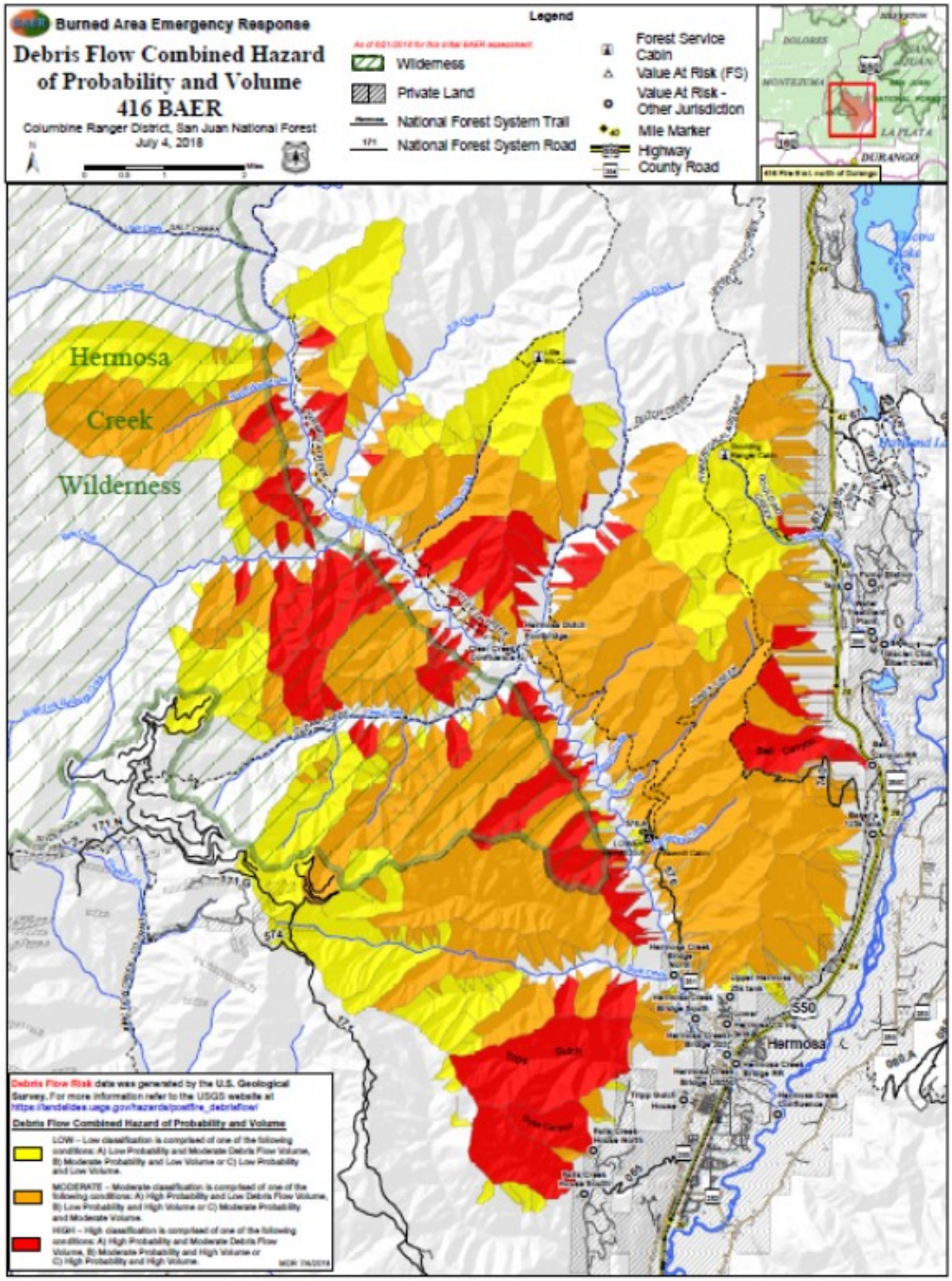
Figure 3. USGS Combined Probability and Volume Predicted Debris Flow Potential.


Burned Area Emergency Response
Debris Flow Combined Hazard of Probability and Volume
416 BAER
Columbine Ranger District, San Juan National Forest
July 4, 2018
Legend
Wilderness
Private Land
National Forest System Trail
National Forest System Road
Forest Service Cabin
Value At Risk (FS)
Value At Risk - Other Jurisdiction
Mile Marker
Highway
County Road
Hermosa Creek Wilderness
Hermosa
550
Debris Flow Risk data was generated by the U.S. Geological Survey. For more information refer to the USGS website at
Debris Flow Combined Hazard of Probability and Volume
LOW – Low classification is comprised of one of the following conditions: A) Low Probability and Moderate Debris Flow Volume, B) Moderate Probability and Low Volume or C) Low Probability and Low Volume.
MODERATE – Moderate classification is comprised of one of the following conditions: A) High Probability and Low Debris Flow Volume, B) Low Probability and High Volume or C) Moderate Probability and Moderate Volume.
HIGH – High classification is comprised of one of the following conditions: A) High Probability and Moderate Debris Flow Volume, B) Moderate Probability and High Volume or C) High Probability and High Volume.

IDENTIFIED VALUES AT RISK

The BAER team analyzed the fire related threats to the identified values-at-risk for potential impacts from increased stream flows, loss of water control on trails and roads, increased debris flow risk, increased sediment delivery to streams, and establishment of invasive weeds. The team used a risk matrix (Probability of Damage or Loss and the Magnitude of Consequences) to evaluate the risk level for each value identified during the BAER assessment.

Human Life and Safety

Substantial threats to life and safety exist in and below areas of high and moderate burn severity. The greatest concerns are in the southern portion of the fire due to increased debris flow potential. Debris flows can be initiated with as little as 0.25 inches of rain. Rain gages have been established in key areas to provide advanced notice of rainfall events that could cause debris flows.

Roads and Trails

Roads and trails within the San Juan National Forest are currently closed and will remain closed until hazards are mitigated and crews conduct repair work. Restoration of the roads and trails will include rebuilding and stabilizing the road base and trail tread, reconstructing drainage features, removing fallen logs, and repairing stump holes. Hazard trees will be removed at trailheads and campgrounds, where users are concentrated, but not along roads and trails. 32.5 miles of trail and 6.9 miles of road were burned over.

Noxious Weeds

Noxious weeds are the most serious ecological threat, due to the fact that large burned areas open the watersheds to the rapid spread of species adapted to colonizing disturbed soils. Noxious weeds displace native species and can disrupt ecological relationships and connections, reducing ecosystem stability. The appearance, function, economic values, and resilience of large landscapes can be substantially changed by invasive species. The BAER team recommends conducting noxious weeds surveys in areas of moderate to high burn severity that are most prone to the spread of noxious weeds (along roads and trails) and treating them early.

Fisheries

Changes in supplies of water and sediment are commonly observed after wildfire. The increase in sediment can reduce macroinvertebrate populations, reduce spawning areas, negatively affect trout habitat and impact native cutthroat trout species. Inter-agency coordination with the Colorado Parks and Wildlife is ongoing to mitigate potential threats to these fisheries.

CONCLUSION

The BAER team has identified imminent threats to values at risk based on a rapid scientific and engineering assessment of the area burned by the 416 Fire. The assessment was conducted using the best available methods to analyze the potential for flooding and debris flows. Options for reducing post-fire peak stream flows, soil erosion, and debris flow potential are limited due to the nature of the burn, rugged topography and slope characteristics. As a result, treatment recommendations focus on mitigation measures to minimize loss of life and damage to values at risk. These mitigations include area closures, warning signs, and public safety approaches such as installation of an early warning system to notify area residents and users of when damaging storms may be approaching.

The findings provide the information needed to prepare and protect against serious post-fire threats. Agencies and landowners are encouraged to use the findings to prepare plans and take actions to protect values at risk. The following websites provide additional information.

Websites

San Juan National Forest Alerts and Closures

https://www.fs.usda.gov/alerts/sanjuan/alerts-notices

416 Fire Incident Information Website

https://inciweb.nwcg.gov/incident/5822/

Live Weather Radar

http://www.intellicast.com/Local/WxMap.aspx

La Plata County Emergency Notification and Services

http://www.co.laplata.co.us/emergency